Volume 28 March, 1942 *Number 3*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Bottling and Food-Packing Machinery

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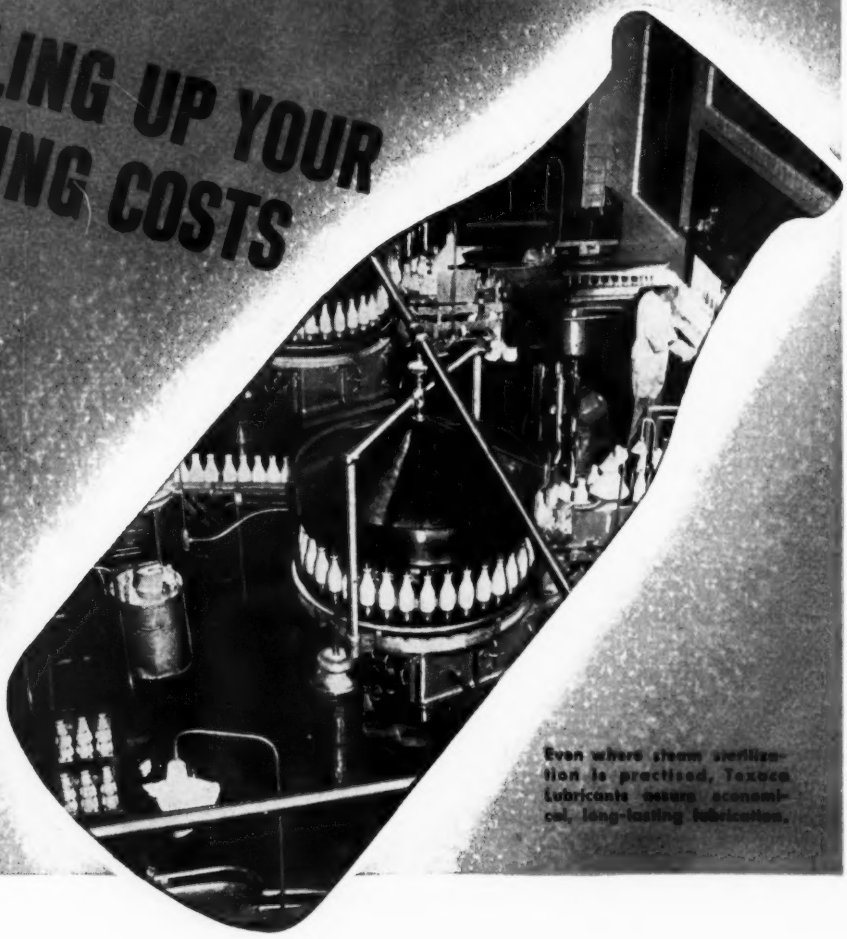

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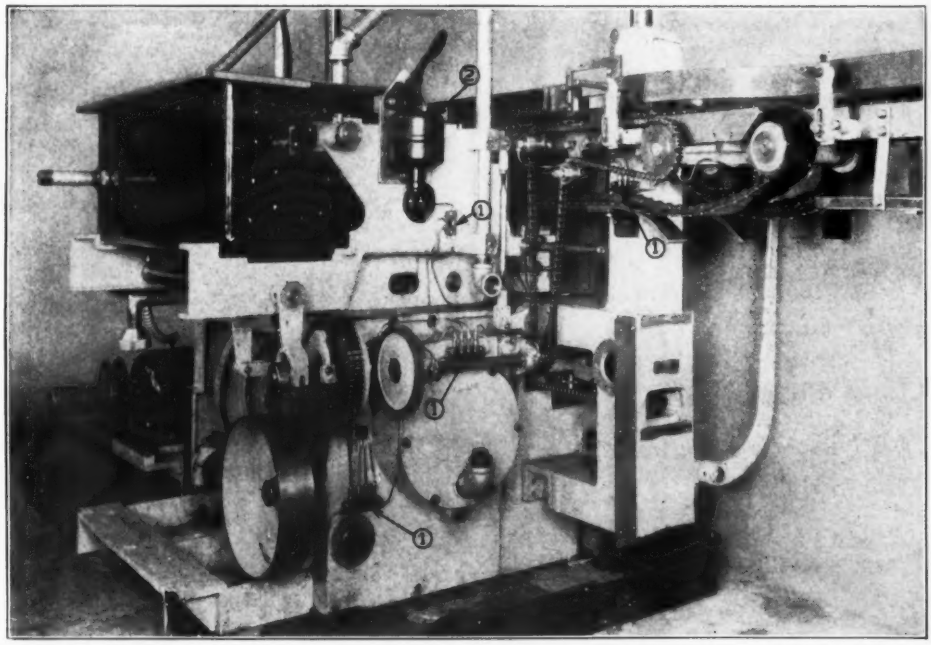
Bottling and Food-Packing Machinery



Courtesy of Pneumatic Scale Corp., Ltd.

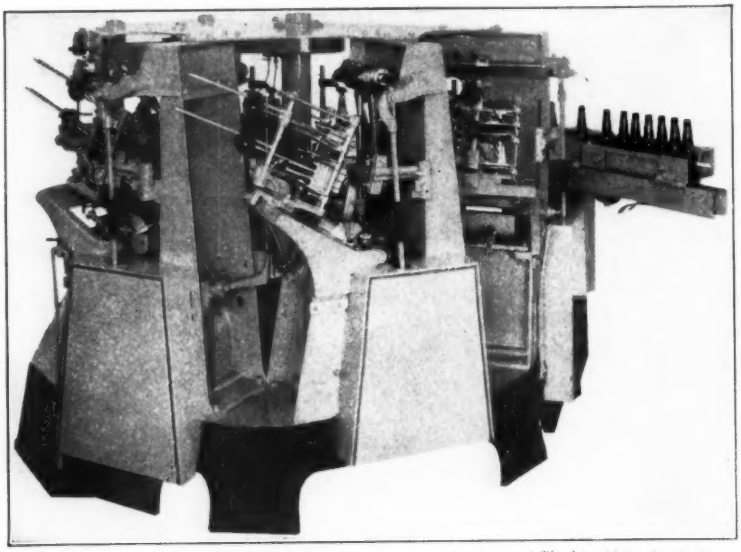
Fig. 1—A straight-line vacuum filler showing at (1) a number of points for centralized oiling and at (2) the hand pump for the oiling system.

THE machinery for packing foodstuffs and beverages in glass is distinctive for the intricacy of its design. One is equally entranced by watching it operate, for the containers seem to flow to it in an endless stream. At a pre-determined moment a gush of fluid or charge of jam, etc., comes from some mysterious part of the interior, then a gadget clamps on a cap and lo!—a bottle of beer or jar of marmalade; and they leave the machine as rapidly as the empties are delivered for filling.

A TRIBUTE TO THE DESIGNING ENGINEER

This remarkable assembly of synchronized motions as exemplified by the modern bottling and capping machines is a tribute to the

ingenuity of the designing engineer. He was a foresighted individual for he realized that no mechanism could function without lubrication, so he provided equally positive devices for delivery of lubricants. Also, he made liberal use of ball and roller bearings, of encased gears and chains for power transmissions, and of automatic speed controls. Again he realized the value of protected lubrication by selecting parts which could be termed self-lubricated.



Courtesy of The Liquid Carbonic Corp.

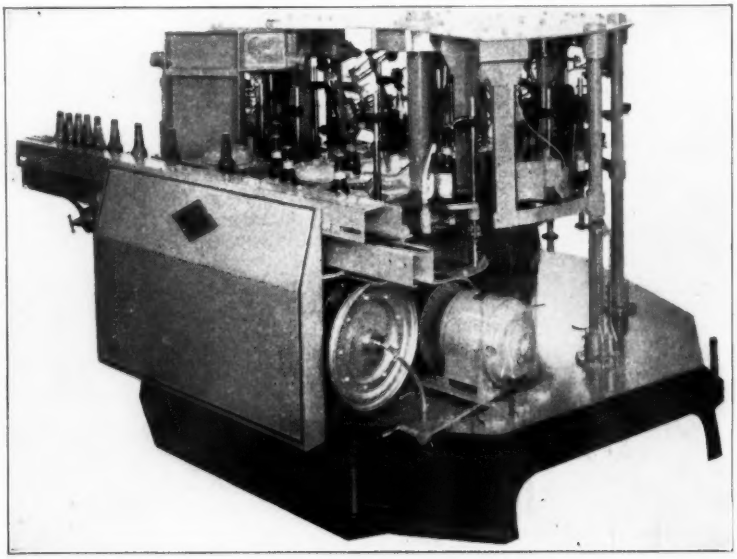
Fig. 2—Rear view of a "Liquid" Triplex Labeler. This machine operates at a capacity rate of from 200 to 250 containers per minute.

THE NATURE OF THE LUBRICANTS

For those who must operate such machinery, it is fitting to discuss the requirements they must consider when selecting lubricants. As we are dealing with machinery handling perishable materials which may have their value ruined by contamination—this requires every consideration, but it should rarely occur, for design provides for positive retention of lubricants. It is only necessary to use them intelligently, assuming that they have been selected so that they possess characteristics suited to the operating conditions. To realize this we will discuss the basic essential operating mechanisms as to construction and design for lubrication; in other words, the bearings, gears, chains and cams.

PRESSURE-LUBRICATED BEARINGS

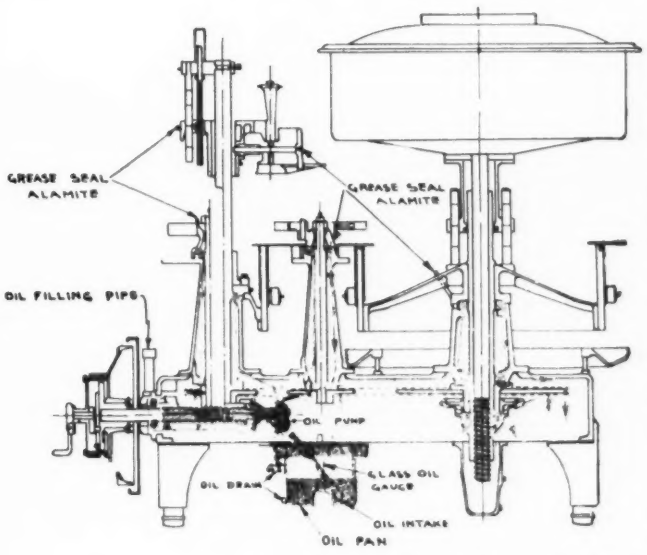
Pressure lubrication has been widely applied to much of the machinery used in bottling and food packaging for the reason that it can be controlled; thereby it becomes a factor in the prevention of contamination. Originally, pressure lubrication, when grease was involved, implied the use of the screw-down type of grease cup. Since the cap had to be screwed down by hand as the grease was used up, wide variations resulted in the amount of pressure applied to the grease according to the strength and enthusiasm of the operator. Nor did he know when to stop turning until grease exuded from some part of the bearing. On the plain bearings of rough, heavy duty machinery this might lead only to waste of grease, it may even be helpful as it prevents entry of abrasive dust, but on a ball



Courtesy of The Liquid Carbonic Corp.

Fig. 3—Side view of the machine shown in Fig. 2 showing details of the speed control and power transmission devices. These units must be perfectly synchronized and, hence, properly lubricated.

or roller bearing too much pressure may cause the bearing seals to become ineffectual. Then grease leakage as well as entry of contaminants may result. It is obvious how serious this would be on a bottle washing machine, etc., where there is possibility of excess lubricant getting into the container.



Courtesy of Cherry-Burrell Corp.

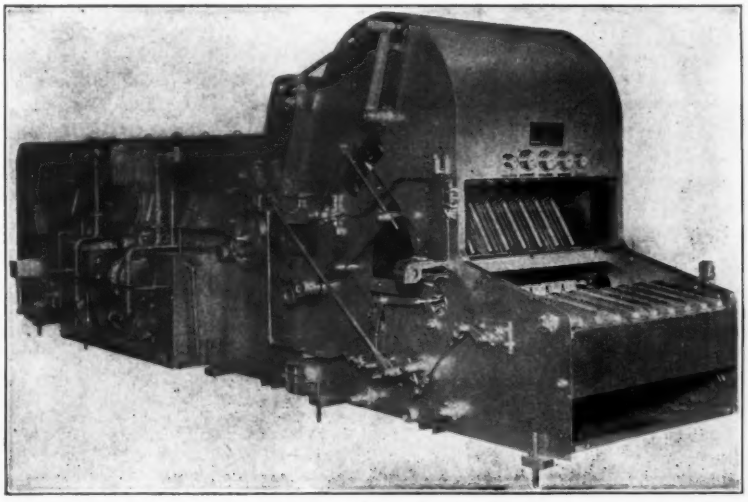
Fig. 4—Lubrication details for a Nuline bottle filler and capper showing points for lubricant application and essential equipment.

The pressure grease gun and the development of centralized pressure grease application, obviated this to some extent. The pressure gun, however, can be misused just as easily as a pressure cup by a careless operator, if he continues to charge a bearing with grease regardless of its apparent capacity. This is only justified where a plain or sleeve type bearing is exposed and subject to contamination by dust, dirt or moisture. Then one must depend upon the charge of fresh grease to force out all the old grease along with any contaminating materials.

Fortunately, there are not many of this type of bearing on a bottling machine. Overlubrication also should rarely be necessary with a ball or roller bearing, where the seals are tight. Then it behooves the operator to use a pressure gun with the utmost care. On the bearings employed in conveyors, food handling or packaging machinery, the capacity for grease is usually very low—oftentimes less than an ounce is necessary; furthermore, any such bearing should never be filled full of grease. About half-full is the recommended charge.

The spring-type (pressure-gun-filled) grease cup was an added refinement which the designer of bottling machinery found he could use to good advantage. This device exerts a certain amount of pressure constantly upon the grease being delivered to a bearing; it can be regulated as to spring tension or valve control so that an excess of pressure is obviated. Constant pressure upon the grease being delivered to any plain bearing which may be exposed to weak acid liquids such as tomato juice or citrus fruit juices, is very beneficial as it prevents possible entry of these fluids and subsequent corrosion of the shaft or bearings.

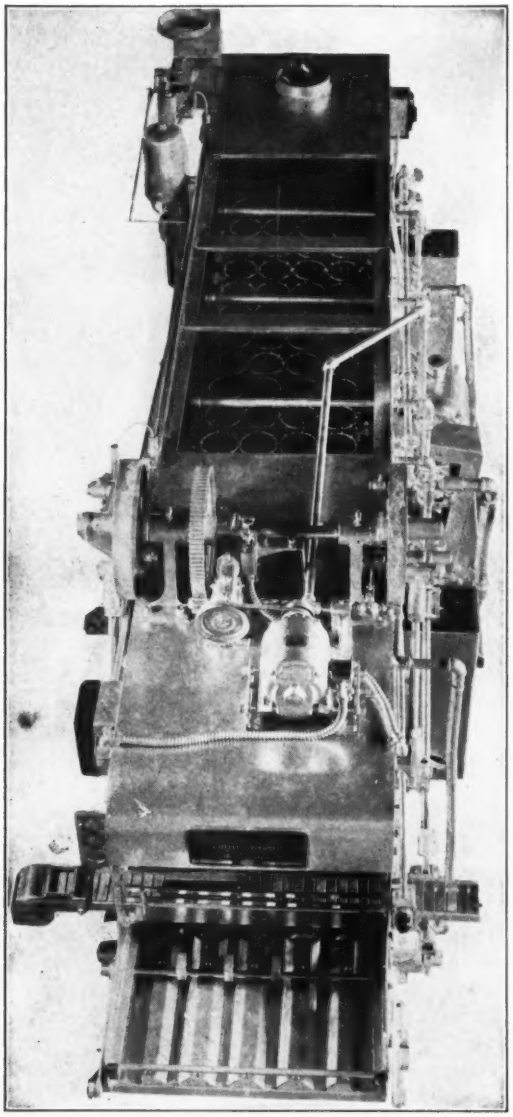
On the other hand, constant pressure on the lubricant should only be employed when dealing with plain or sleeve type bearings. If applied to a ball or roller bearing, overcharging will probably result. Then the power



Courtesy of The Heil Co.

Fig. 5—Side view of a Heil Nu-Way bottle washer with capacity for 48 bottles per minute.

required to turn the bearing will be increased due to the resistance of the grease to churning. Later, grease may be forced out past the bearing seals to cause them to leak, as already mentioned. It is most important to have a



Courtesy of The Heil Company

Fig. 6—Top view of a Heil bottle washer. Note gearing and motor drive where careful lubrication is necessary.

tight bearing seal in any type of bottling machine where fruit and vegetable acids may be present. In many of the operations a considerable amount of juice is involved; if it gets into a ball or roller bearing it will be of such a nature chemically as to cause corrosion, particularly if the lubricant does not completely cover and protect the bearing parts.

Grease Stability

This brings up the matter of selection of bearing lubricants, especially greases. Lubrication recommendations are very helpful; but they only serve as a purchasing guide to the operator of bottling or food-packing machinery. They do not denote grease or oil characteristics, nor indicate any relation to means of application. A few words as to greases should be of particular interest as they are depended upon so widely in this industry for bearing protection.

The petroleum chemist has done a masterful job in developing grease formulae and manufacturing procedures which produce greases of marked stability. In brief, stability as it pertains to the chemical nature of a grease is an excellent measure of its lubricating ability and endurance. This latter is most important, for a charge of grease on any intricate mechanism must function dependably for a considerable period of time. On the ball bearing several months may transpire between lubrication periods; obviously an asset when the bottler must take on additional production requirements which call for labor elsewhere in the plant. Stability also means that the grease will be resistant to breakdown or oxidation. It must also be resistant to acetic acid and other weak acids which are present in some types of fruits or food materials. These acids, if they come in contact with a grease, may decompose the soap content of some greases, leaving a mixture of fatty acid and lubricating oil. Leakage and sludge formations would be an indication of this type of grease breakdown. Sludge is always very objectionable, inasmuch as it may cause clogging, and prevent complete passage of the lubricant through the adjustment bearing clearances in the crowner housing. Sludge may also be the cause of gumming and varnish-like deposits.

Lubricating Ability in the Presence of Moisture

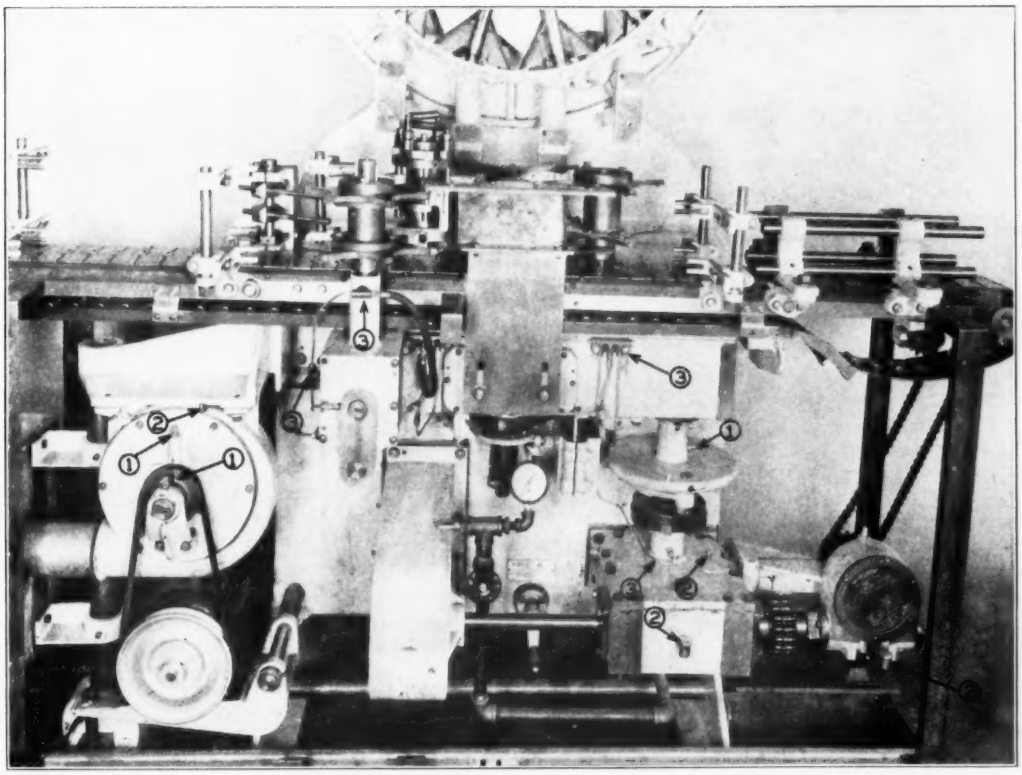
As beverages and food products are usually possessed of a high moisture content, the possibility of moisture-contamination of lubricants is of importance. In this consideration it is necessary to include gears and chains as well as the bearings. Wherever continued exposure to or contact with moisture or fruit and vegetable acid fluids may prevail, the lubricant should be able to emulsify with water to some extent. In this way a lubricating film is formed which will be resistant to the washing action such as might occur on a bottle washer or in sterilizing machinery.

Emulsification is promoted by compounding straight mineral oils with a small amount of

animal or vegetable oil. In other words, when certain of these latter (termed fixed oils) or some types of soaps are added to a mineral oil, if the subsequent compound is mixed and agitated with water, the resultant emulsion of the two liquids will separate very slowly or even stay in an emulsified state indefinitely. Emulsification is essentially a physical reaction but a very necessary one wherever lubrication under wet conditions is required. Some sodium soap greases behave in a similar manner. Emulsions are usually quite tenaceous or sticky. On the other hand, they may not be very stable chemically, in which case they may become corrosive due to increased acidity. A condition which may be accelerated if the contaminating liquors are acid in nature such as tomato or fruit juice. Then there is likelihood that the emulsion in question may become actually gummy due to oxidation. This can be retarded, however, if the lubricant has been carefully refined with respect to removal of unstable hydro-carbon components which are most easily oxidized. The machine operator can help by observing regular and frequent periods of renewal of lubricants and establishing a cleaning schedule.

The relation which acidity bears to emulsification and sludge formation has formed the basis for considerable study due to the extreme complexity of the acid-forming constituents such as sulfur and oxygen and the limited knowledge of their reactional tendencies.

Were these reactions more clearly identified or could petroleum oils be refined so as to entirely remove or neutralize their organic acid-forming constituents, the problem of corrosion might be materially simplified. Until this objective is attained, effort can only be made to render such oils as chemically stable as possible, especially when they are to be exposed to moisture and oxidizing conditions in the lubrication of bottling and food-packing machinery.



Courtesy of Pneumatic Scale Corp., Ltd.

Fig. 7—A Pneumatic Rota bottle cleaner showing at (1) points for grease gun lubrication; at (2) points for hand oiling and at (3) a number of the junction boxes and oil lines in the centralized oiling system.

Saponification—a Factor in Grease Making

In contrast with emulsification, saponification is a chemical reaction which has to do with the production of soaps by treatment of a fatty oil with certain types of alkaline solutions. It is one of the essential steps in grease making.

One of the distinctive differences between

fixed or fatty oils and petroleum oils involves the ability of the former to undergo a simple chemical reaction whereby the original compounds are split up and their elements recombined chemically with certain alkalis. When the larger portion of the fatty oil molecules are combined with a metal such as sodium, calcium or aluminum, a soap adaptable to grease making is formed by this phenomenon of saponification.

The petroleum chemist prepares these soaps so that they will resist the dissociating effect of water, or will emulsify according to intended service. Then he carefully selects his mineral oil constituent and plans a method of procedure which will give a high temperature grease, a water-resistant product or one of fibrous nature. All according to the basic materials the temperatures involved in mixing, the rate of mixing, and whether the finished grease is poured hot or cold.

The lubricating engineer recommends these greases in the bottling plant according to the operations to be served. On ball bearings, he would use a sodium soap product of high chemical stability to protect against bearing corrosion as far as possible. Where he desires a grease to resist breakdown in the presence of moisture, he would use a lime soap grease. These are terms well known to the oil industry, but perhaps not so familiar to the bottler or food packer. Brief definition is therefore advisable. For example:

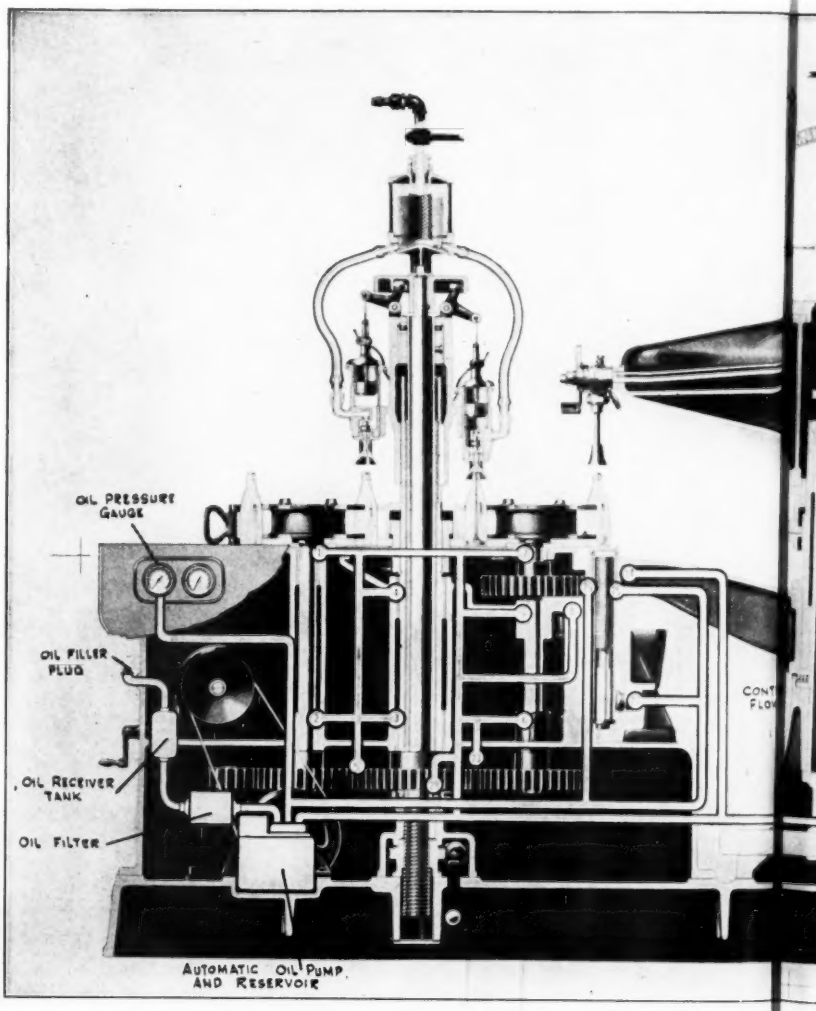


Fig. 8—Typical diagrammatic sectional view of a CEM Syruper-filler-crowner showing the automatic

Lime Base Greases

These are made by compounding lime (calcium) soaps with a mineral oil of varying viscosity according to the prospective duty. They are smooth, yellow to amber in color and of a buttery texture. By preparing them so that they are entirely dehydrated they can be used at operating temperatures somewhat above the boiling point of water.

Sodium Base Greases

Soda soaps produce a grease of longer fibre especially when compounded with heavy bodied oils within the SAE 80 to 250 range. Such lubricants can be used at temperatures approaching 400 degrees Fahr. They are very effectual on equipment where construction or wear may allow leakage of the lubricant. Here the structural nature of a sodium soap grease plus the natural adhesiveness enables it to resist being forced out of bearing clearances. It also tracks or trains well in ball or roller bearing assemblies. Sodium base greases are noted for their resistance to breakdown; they do not oxidize readily, hence they are dependable lubricants for precision mechanisms such as are involved in the bottling and capping machine.

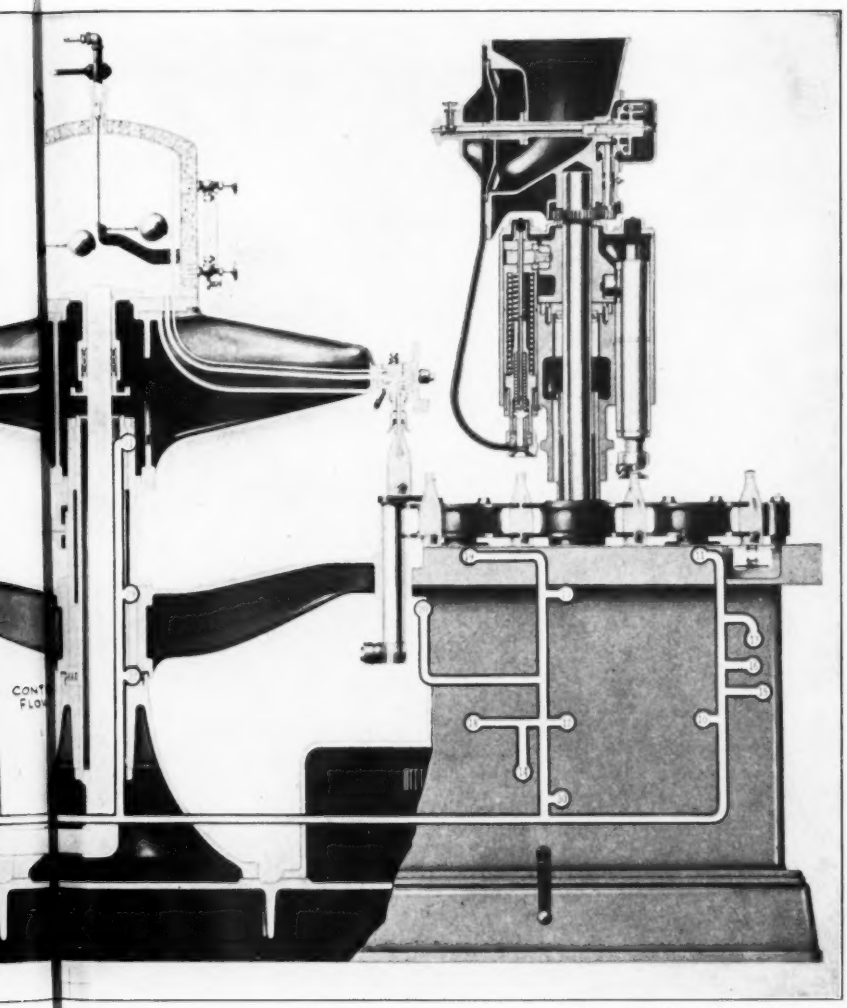
CENTRALIZED PRESSURE OILING

The designer of bottling and capping machinery has gone quite extensively to application of the centralized pressure system of oiling. In this way he enables the operator to accomplish lubrication of a considerable number of plain bearings while the machine is running. Automatic delivery of oil by means of a centralized pressure system insures positive and measured lubrication of enclosed parts which might otherwise require shut down and partial disassembly were unit lubrication necessary. Such a system operates from a central control panel, all the parts connected thereto being flushed and automatically supplied with a measured amount of oil from a central reservoir.

The control panel and reservoir are normally located adjacent to or attached to the machine to be lubricated. The "Pre-Oil" button or control lever is, therefore, within ready reach of the operator. As it functions by means of a plunger which operates the oil pump, all that is necessary is to operate the discharge mechanism when each bearing will automatically receive a charge of oil. The manufacturers of the bottling machines equipped with such systems recommend a daily oiling schedule emphasizing particularly the necessity for operating the oiling system before starting the machine to prevent starting wear.

The amount of oil delivered is restricted to as nearly as possible the theoretical requirements of the respective parts, being measured by drops. This is accomplished either by using specially constructed drip plugs or control outlets, by using a control device located at the base of the pump or by installing suitable adjusting manifolds at certain points in the system.

When a centralized pressure oiling system is properly installed it is claimed to be relatively fool-proof, simple to operate and dependable in its delivery of clean oil to all the parts served. To further insure this, suitable oil filtering media such as a felt pad or screen, are employed to remove any foreign matter that may have entered the oil during storage or handling. Figure 8 shows a typical layout of the oiling lines for such a system.



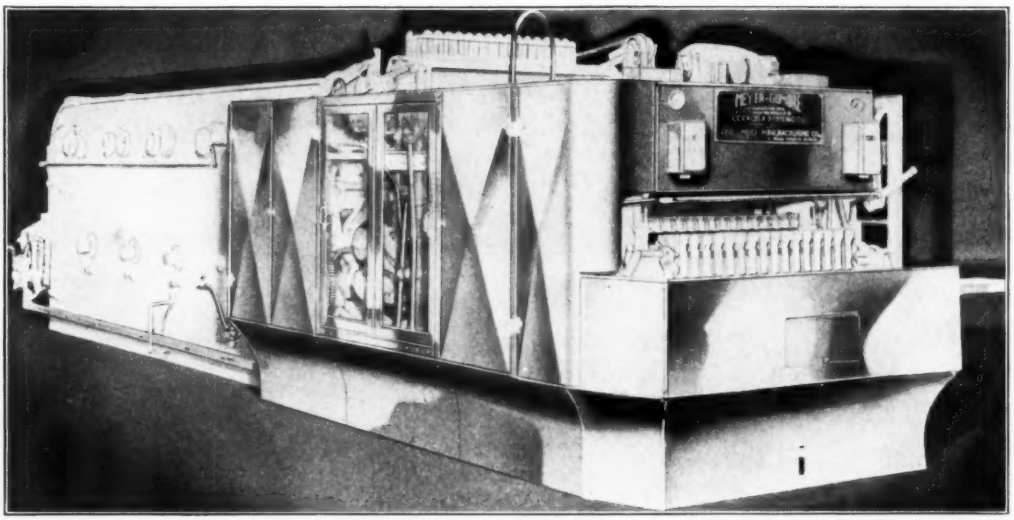
Courtesy of Crown Cork and Seal Co.

e auto ication system. Note points identified. White lines indicate oil piping.

Pulsating Control

It is possible to design a centralized pressure oiling system so that hand control can be eliminated, by utilizing the principles of pulsation and employing a suitable pressure control valve to regulate the oil flow. Here the lubricator itself is driven by a belt or gear connection from some rotating part of the machine to be lubricated. This is very advantageous where an extensive number of

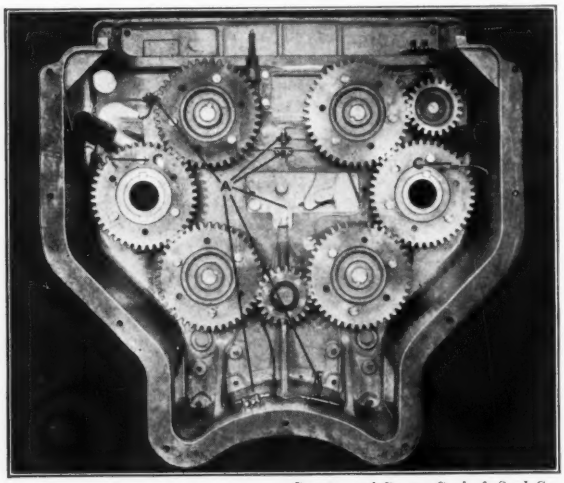
parts are to be served, for the automatic feature eliminates the possible factor of human error. The only attention required is when any individual feeder is to be adjusted or the oil reservoir is to be filled.



Courtesy of Geo. J. Meyer Mfg. Co.

Fig. 9—Exterior of a Meyer DUMORE bottle cleaner. Note certain of the operating mechanisms at the side. This machine is extensively provided with means for automatic lubrication.

Where pulsating control is used, the oil is fed only during a pulsation or high pressure period in the cycle of pump operation—control being maintained by a suitable plate valve arrangement. An added feature is the practicability of flushing the entire system under the prevailing pressure at the high pressure period by pressing the flushing button on the pump unit.



Courtesy of Crown Cork & Seal Co.

Fig. 10—Part of the driving mechanism of one bottling unit. This is fully protected and completely lubricated. "A" indicates certain parts of the centralized automatic oiling system; "C" shows oil leads to certain of the gears.

GEAR AND CHAIN SERVICE

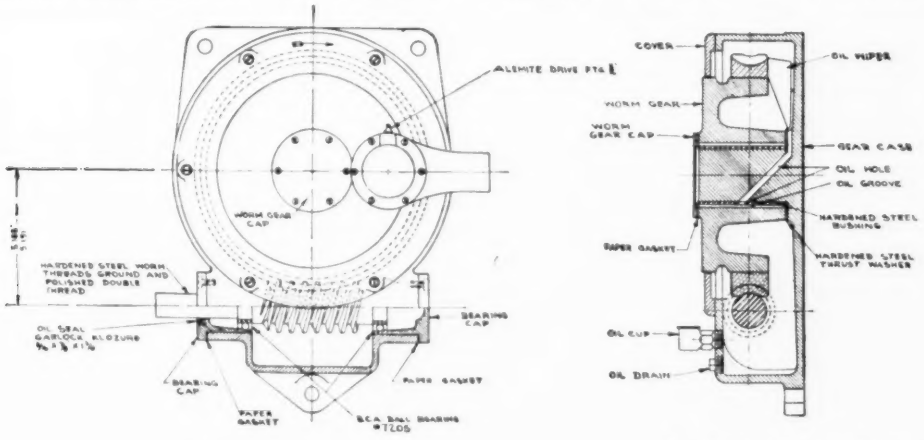
Bottling, crowning, syruping and other food-packing machinery all require a considerable assembly of gears and chains in order to obtain the necessary speed reduction or transmission of power which make these units so automatic. Spur and bevel gears are widely used, some being housed, others exposed, though usually within the general enclosure of the machine.

In planning for the lubrication of gears and chains, it is well to consider the operating speeds in order to anticipate the extent to which centrifugal force might cause the lubricant to throw off from the moving parts. Here there is a definite relationship between speed and the adhesive characteristics of the lubricant. This will be especially true on exposed gears or chains. Oil throw might not be too serious within the closure of a bottling machine; in fact, it might throw some lubricant to adjacent chains to keep them lubricated. Ultimately, however, a sloppy condition would develop within the housing which would require cleaning.

For this reason, the designing engineer always studies the practicability of using proper housings. In an oil-tight gear or chain housing, a comparatively fluid oil can be used, especially if it can be circulated automatically and not merely distributed by the dipping of the gear teeth or chain sprockets in a bath of the lubricant. Centralized pressure oiling is also practicable to some extent on the bottling machine. See Fig. 10.

Where gears and chains are not tightly housed, however, thought must be given to the

adhesive characteristics as well as the viscosity of the lubricant. This is why straight mineral petroleum oils are more adaptable to such installations than compounds such as greases.



Courtesy of Cherry-Burrell Corp.

Fig. 11—Lubrication details for a CC spray pasteurizer.

It is an important item which should be borne in mind, particularly by the installation engineer.

Certain types of cylinder stock greases will have comparatively high adhesive tendencies. On the other hand, they will be more expensive and not as resistant to moisture conditions as straight mineral gear lubricants. The latter are, therefore, preferred in the lubrication of bottling and food-packing machinery. In their application, one should study the operating conditions prior to deciding how heavy a product to use, taking into account the size, the probable gear tooth pressures, the maximum speed and the manner of housing.

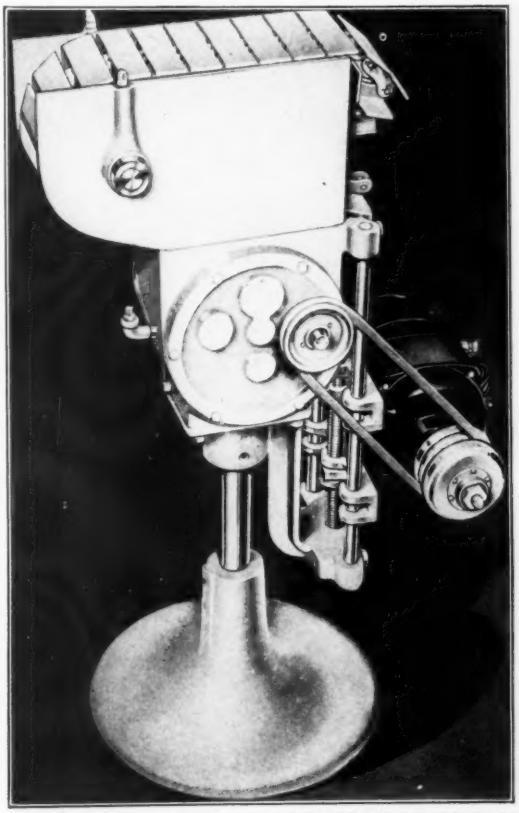
The Roller Chain Predominates

The conventional roller chain predominates on food packing machinery. Normally, the same lubricant as provided for the gears can be used effectually on this type of chain. Frequently, an automotive type of gear lubricant within the SAE 140 range can be used to good advantage for both.

The chief duty of the lubricant on any chain is to penetrate through the link clearances to prevent wear. This is most important on a bottling or food packing-machine, for wear might lead to chain stretch, which in turn would disturb the synchronism between the other parts of the machine.

PRESSURE AND LOAD

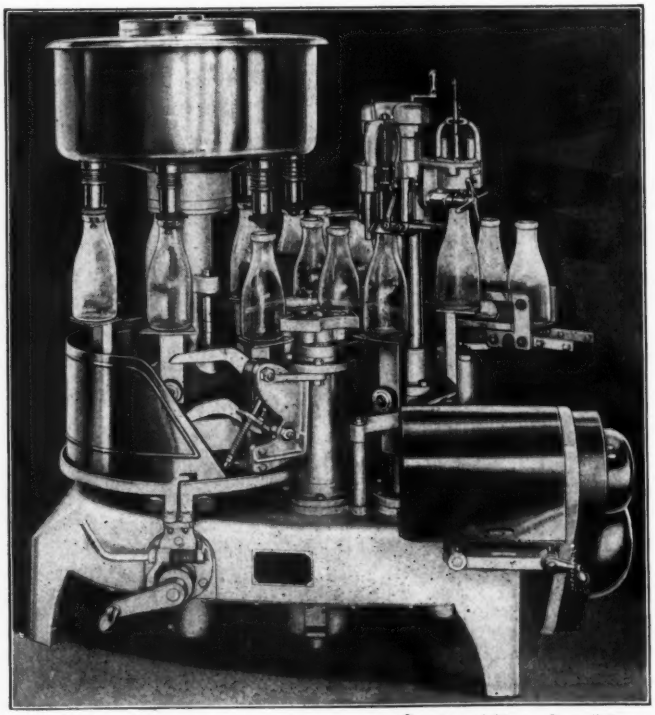
The designing engineer of a bottling, filling or capping machine must consider bearing and gear tooth pressures from the time he makes his first layouts, due to the relation of pressure to the size of the component moving parts of the machine. He is not so much concerned with speed, for this industry does not rush machinery. Speed, in fact is referred to in terms of bottles or packages turned out per minute rather than in terms of RPM. The



Courtesy of U. S. Bottlers Machinery Co.

Fig. 12—A dead end crossover—used after automatic handling of the container is finished and where transfer for hand finishing is necessary.

installation and lubricating engineers are concerned with pressures on account of the effect which it may have upon the performance of lubricants and life of bearings, chain links, cams or gear teeth. If the viscosity or consistency of a lubricant is not sufficient to withstand any squeezing-out action which may be developed due to the construction of the moving parts, considerable damage will probably follow due to lack of proper lubrication. So pressure must be carefully considered in the study of any lubricating problem, prior to decision as to the most effective manner of lubrication.



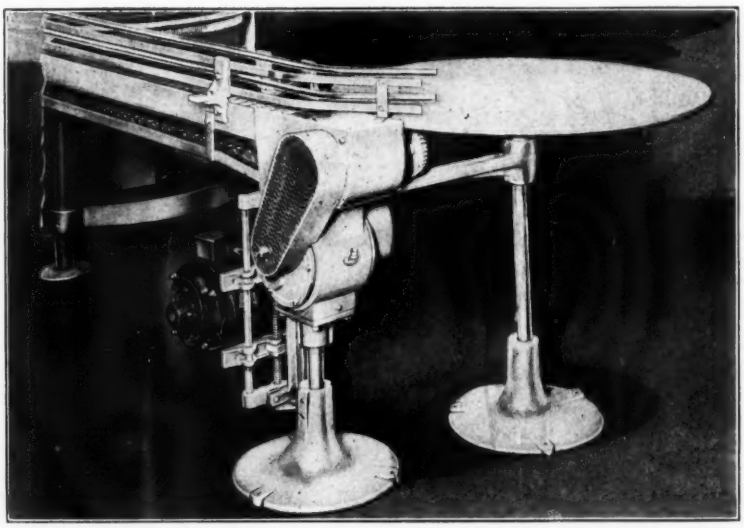
Courtesy of Cherry-Burrell Corp.

Fig. 13—Exterior view of a Model G 70 Nuline milk bottle filler and capper. Note closures of operating parts.

Pressure is both static and operating. Static pressure is developed by virtue of the dead weight, or stationary load, operating pressure is developed when the machine is running. The greater the combined static and operating pressures between any two contact elements, the heavier or more viscous must be the lubricating film in order to prevent metal-to-metal contact, for pressure will tend to squeeze out the lubricating film from between the wearing surfaces. In a bearing, the essential solution to this problem will be adequate bearing area and proper grooving.

Danger of impaired lubrication due to pressure can be further reduced by enclosed construction, and subjecting the parts to controlled lubrication. Fig. 7 illustrates this idea very well. Relative to the development of such pressures, however, it must be remembered that the period of maximum intensity may often be comparatively brief. Sometimes pressure can be met with pressure, the lubricant being maintained within the clearance spaces under the prevailing pressure of some form of pumping device. This calls for a relatively tight lubricating system throughout, viz., the centralized pressure system as applied to the bottling machine.

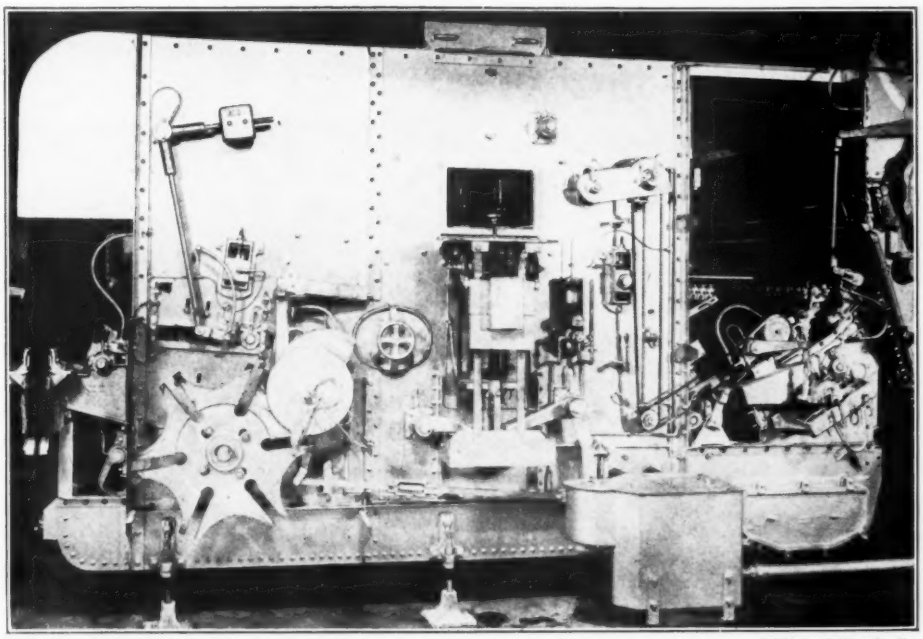
Machinery construction, manner of operation and means of application will influence the viscosity range a lubricant should possess in order to meet the probable pressure conditions. So a primary study of these conditions should always be made in order that



Courtesy of U. S. Bottlers Machinery Co.

Fig. 14—Mechanisms essential to a revolving accumulating table. Note protected motor and conveyor drive.

the severity of the duty may be judged. With such knowledge as a basis and an understanding of what is actually involved when the terms "viscosity" or "body" are used, the problem of selecting either oils or greases should be materially simplified and subsequent successful operation assured.



Courtesy of Michael Yundt Co.

Fig. 15—Side view of the washing end of a Yundt bottle washer showing some of the details of the Farval centralized pressure grease lubricating system, such as tubing and measuring valves that meter grease to the bearings.

The nature of the lubricating system, the operating conditions, such as speed and bearing pressures and details of construction such as manner of grooving, will usually dictate whether an oil or a grease should be used. The size, duty and pressure conditions of the moving parts of certain bottle filling and crowning machines have rendered it advisable to provide for positive automatic lubrication. Greater convenience results with marked savings in labor due to reduction in the amount of attention necessary.

Operating Pressure

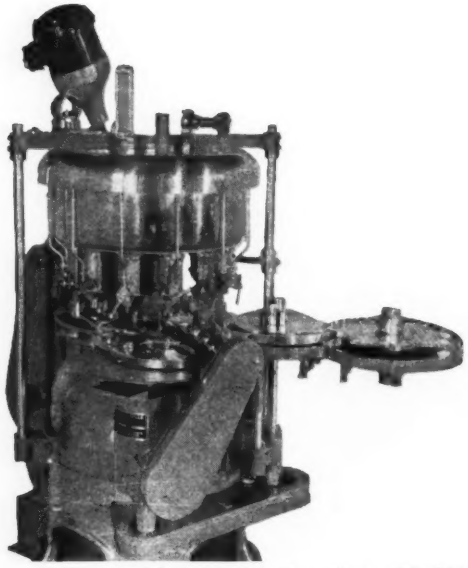
Operating pressures are developed by machinery in motion. If it is necessary to idle, due to some delay in delivery of jars or bottles, or perhaps the material to be packed, the pressures which may exist between the teeth of the gear trains, or upon the bearings of certain of the shafting may not be abnormal. When idling there should, therefore, be no serious lubrication problem.

Under operation, however, pressures developed may be so severe as to cause a reaction pressure back through practically all the moving elements of the machine. Not with the same intensity in every case, to be sure, for this will depend upon the size or relative importance of the parts involved. Such reactionary or back pressures, on the other hand, may be considerably in excess of the idling pressure, and hence they will be a potential cause of wear, excessive power consumption and lubricating difficulties.

The body and adhesive ability of any lubricant for such service are most important in order that it may be able to withstand being squeezed out from between gear teeth, chain link connections, or bearings and shafting. These characteristics in the lubricants must be regarded from the viewpoint of maximum pressure involved, even though this may result in abnormal internal friction within some lubricants when certain types of food-packing machinery may be idling. It is far more important to prevent metal-to-metal contact under the prevailing operating pressures and thereby preclude the development of abnormal wear, than to reduce power consumption during idling. This is especially true since food-packing machinery to develop maximum efficiency should idle as little as possible.

FLUSHING AND CLEANING OF LUBRICATED PARTS

The nature of the products being bottled or packaged requires that many parts of a bottle washing, filling or food-packing machine be flushed and cleaned at regular intervals. Otherwise the lubricants might become contaminated, to increase wear and power consumption instead of functioning to the contrary.



Courtesy of Food Machinery Corp.—Sprague-Sells Division

Fig. 16—Showing the type of machinery for filling free-flowing liquids into small containers.

The frequency of any cleaning procedure will naturally be governed by the design of the parts involved, the extent to which they are protected and the conditions to which they are exposed. Obviously, open gears or chains will require more attention than sealed ball or roller bearings. Furthermore, some mechanisms automatically flush themselves; for example, the ring or chain oiler so widely used on certain sleeve-type motor bearings. Other methods of periodic lubrication are not so capable; here, if foreign matter gets in it stays there until the mechanism in question is flushed and cleaned, viz., certain of the pressure gun grease lubricated bearings on the bottle cleaner or filler.

Sealing of a bearing, chain housing or gear-set not only prevents or at least retards the entry of foreign matter, but also automatically protects the working parts and the charge of lubricant. It is especially important to protect ball and roller bearings as churning of abrasive foreign matter with grease may cause serious damage to the bearing elements. Complete sealing, however, is rarely possible where a considerable assembly of intricate mechanisms is involved; nor can the method of sealing be always depended upon. Hence, the necessity for periodic flushing and cleaning.

The procedure can be patterned after the procedure adaptable to electric motors, viz., use a comparatively light straight mineral oil which has been heated to around 140 degrees Fahr. Application while the machine is running is often advisable, with the drain plug removed to permit of draining of any soap or foreign matter which is flushed off by the wash oil. Hydro-carbon solvents are not advisable especially where greases have been used, due to the possibility of non-soluble soap residues remaining after their oil content has been taken up by the solvent. This method of procedure can be applied equally well to ring-oiled bearings as to the speed reducers, etc.

Wherever it is necessary to clean grease lubricated ball or roller bearings which are so designed as to preclude draining, the bearing seal or cover should be removed and the old grease wiped out as thoroughly as possible before re-lubrication. Bearings of this type can be hand-packed, permitting of quite accurate control of the volume of grease charged.

CONCLUSION

In this brief discussion of certain of the fundamentals involved in the lubrication of bottling and food-packing machinery, we have endeavored to stress the importance of protected lubrication. "Time out" for any purpose always means loss of production. Normally that would be taken for granted and the essential repairs or cleaning would be made in due course.

Lubrication in those days was regarded too often as a necessary evil—to be purchased at lowest cost, forgetting its value as a means of machine protection.

Today, however, machine protection is uppermost in the mind of every operator—first, because it enables him to work longer hours and produce more goods in the interest of National Defense; second, because he may not be able to obtain repair parts immediately if a machine fails, due to wear or breakdown.

Food products are as necessary as fighting materiel. We could not manufacture or use one without the other, for armies still fight on their stomachs. The food packer realizes this and his efforts to cooperate by the use of some of the most perfectly lubricated machinery in industry is indicative of his "all-out" interest.

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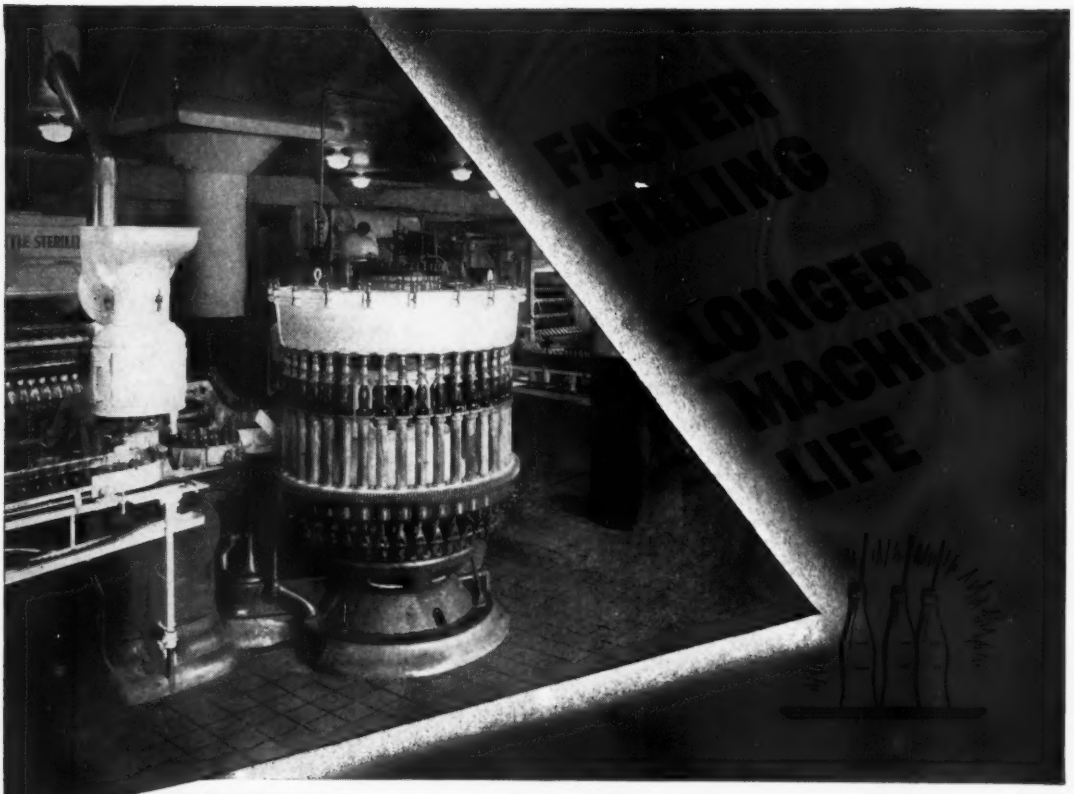
FOR BOTTLING AND FOOD PACKING MACHINERY

Conveyors, Elevators and Line Shafting

PLAIN BEARINGS	
Oil Lubricated	Texaco Canopus Oil
Grease Lubricated	Texaco Star Greases
BALL OR ROLLER BEARINGS	
Grease Lubricated	
Light to Medium Duty	Texaco Starfak Grease No. 2
For Heavy Duty	Texaco Starfak Grease No. 3
Oil Lubricated	Texaco Canopus Oil

Bottling, Packing and Power Transmission Machinery

ELECTRIC MOTORS	
Oil Lubricated	Texaco Canopus Oil
Grease Lubricated	Texaco Starfak Grease No. 2 or No. 3
Built-in Gears	Texaco Algol Oil
GEARS	
Worm Drives	Texaco 650T Cylinder Oil or Thubans
Spur or Bevel Gears	
(Enclosed)	Texaco Thubans
(Exposed)	Texaco Crater No. 1
CHAINS	
Silent Chain Units	Texaco Algol Oil
Exposed Drives	Texaco Crater B or No. 00
PLAIN BEARINGS	
Oil Lubricated	
In enclosed systems	Texaco Canopus Oil
Where moisture may prevail	Texaco Ursa Oil C or Aleph Oil C-10
Grease Lubricated (above 50°F.)	Texaco Star Grease No. 1
(below 50°F.)	Texaco Star Grease No. 00
BALL OR ROLLER BEARINGS	
Light to Medium Duty	Texaco Starfak Grease No. 2
Heavy Duty	Texaco Starfak Grease No. 3
CIRCULATING SYSTEMS	Texaco Algol Oil
GEARING	
Exposed to Water or Acids	Texaco Ursa Oil C or Texaco Aleph Oil C-10
Enclosed reducers according to design	Texaco Thubans



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